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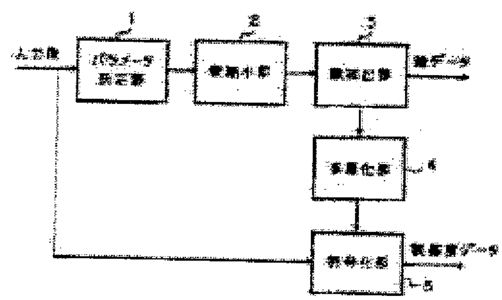
(54) **IMAGE CODING METHOD**

(57)Abstract:
PROBLEM TO BE SOLVED: To decompose received image information properly for coding with smaller data amount.
SOLUTION: A parameter decision section 1 decides a parameter for multi- layer display of an input image. An image reduction section 2 uses a desired reduction filter to reduce an image for the multi-layer display whose parameter is decided. A ridge extract section 3 conducts Laplace arithmetic operation to seek a ridge with respect to the reduced image so as to detect a unit ridge and detects a macro ridge based on the detected unit ridge and calculates the intensity of ridge for each rectangular area enclosing the detected macro ridge.



CLAIMS

[Claim(s)]
[Claim 1]An image is reduced using a desired reduction filter to a multilayer display which determined a parameter for a multilayer display of an input image and as which a parameter was determined, An encoding method of a picture containing a step which performs Laplace operation, detects a macro edge based on a unit edge which detected and detected a unit edge in order to look for a marginal place to a reduced image, and wraps in a detected macro edge, and which computes marginal intensity for every rectangular area.

[Translation done.]

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3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the encoding method of a picture, especially the encoding method of a compressed image.
[0002]
[Description of the Prior Art]A multilayer method is an easy method for obtaining the image display with the field of a different size. The tree (tree) which is useful to coding of an image, especially compression of the image through progress transmission (progressive transmission) as for this display, and is obtained as a result, Quad tree (quadtree) coding (E. "Image compression via improved quadtree decomposition algorithm"IEEE written by M.Feder.) [Shusterman and] Usually it transmits using [Trans.Image Processing, vol.3, no.2, pp207-215-1944, and else].
[0003]A natural image can be divided into the field of a different size with the details and the information on variable quantity. Such segment division of an image is preferred because of the coding with the sufficient efficiency of image data. Quad tree (QT) coding is the main methods showing decomposition of an image, i.e., multilayering.
An image is divided into the rectangular region where two dimensions are homogeneous (homogenous).
The decomposition builds a tree, and each node of a tree has four children, and it relates to the field to which the image was limited uniquely. A root relates to the whole image. When using QT coding for compression of an image, it is required to code the tree obtained as a result. A coding procedure includes coding of coding of tree structure information, and a node / leaf information, i.e., a segment division flag. The parameter which describes the intensity of a corresponding partial image (subimage) is assigned to each leaf. Of course, the pixel of an image will be a leaf whenever it appears in the QT code. Coding of the tree structure should be completed with the level under No. 1, i.e., the level in front of [of a block of the lower limit which can be permitted] one, and this block must be equal to a pixel, or must be larger than it.
[0004]However, QT coding is not utilizing the useful character. A certain block has the still larger likelihood divided into a regional block, when an adjoining block is divided. A background is explained by the fact which comprises a much more big block to the image with this natural character being a thing describing a certain object which should express using a continuous small block. In other words, further compressible spatial relative redundancy exists in the QT code. This means that an image can be decomposed still more efficiently than QT coding by using the technique of expressing an object briefly. There is marginal (edge) information as one of some the candidates for displaying an object. In one method using marginal information, an edge is extracted with a line approximating method (hierarchy form marginal detection). Therefore, although decomposition of an image is carried out based on an edge existing in each block and is useful in the scene of a simple object like the image of the head and a shoulder, it is a difficulty that a redundant overhead, i.e., an edge, causes encoding efficiency lower than QT coding.
[0005]
[Means for Solving the Problem and its Function]In this invention, a multilayering method (Multilayering Scheme) with which it was improved for coding of an image is provided. It is not

necessary to code an edge in accuracy of a pixel, and since what is necessary is just the accuracy of a block level small No. 1 in the case of segment division, marginal extraction can be performed by a reduced image (decimated image). Edge data can also be reduced with complexity of calculation memory space and for marginal extraction, attaining suitable multilayering then.

[0006]An encoding method of this invention determines a parameter for a multilayer display of an input image, An image is reduced using a desired reduction filter to a multilayer display as which a parameter was determined, In order to look for a marginal place to a reduced image, Laplace operation is performed and a step which wraps in a macro edge which detected and detected a macro edge based on a unit edge which detected and detected a unit edge and which computes marginal intensity for every rectangular area is included.

[0007]

[Example]One example including the theoretical consideration which resulted in this invention is described with reference to drawings.

[0008]Quad tree coding is explained below first.

[0009]$L_{t \text{ and } b}$ are considered as the multilayer display of an image. t and b are the parameters showing a top level and a bottom level, respectively, and are T>b>=0 here. This time $L_{t \text{ and } b}$ are defined as follows.

[0010]

[Equation 1]

$$L_{t,b}=\{l_{t,t} \cup l_{t,t-1} \cup \cdots \cup l_{t,i} \cup \cdots \cup l_{t,b+1} \cup l_{t,b}\} \quad (1)$$

$l_{t \text{ and } i}$ are the layers which comprised a block of the size of $2^i x 2^i$, and it means that a decomposition process leaves on the level t and finishes this with the level i about the block.

[0011]Next, a variable is defined. $p_{t \text{ and } i}$ are the number of the blocks of the size of $2^i x 2^i$ divided into four subblocks with the level i−1 low next, i.e., a level.

$q_{t \text{ and } i}$ are the number of the blocks of the size of $2^i x 2^i$ which remains with the same size also below the level i−1, and, for this reason, the block corresponding to this $q_{t \text{ and } i}$ constitutes $1_{t \text{ and } i}$.

It assumes that the size of an input image is a pixel of W(width) xH (height), and the layer of the pixel of an image is expressed as the level 0. The relation between two variables is then expressed by the repetitive equation.

[0012]

[Equation 2]

$$p_{t,i} + q_{t,i} = 4p_{t,i+1}$$
$$p_{t,t+1} = W \times H/4^{t+1} \quad (2)$$

[0013]t fulfills the following conditions.

[0014]

[Equation 3]

$$W \bmod 2^t = 0 \text{ and } H \bmod 2^t = 0 \quad (3)$$

[0015]An example of the multilayer display at the time of being t= 5 and b= 2 as a parameter is shown in drawing 1 in which two bridle wires exist.

[0016]As for an order of coding with each level, a little unlike the case of a square image, the block of the same size becomes an order of a raster scan type. that is, it comes out from the right and a top downward from the left. '1' is assigned to parents' node and '0' is assigned to a leaf. Drawing 2 shows the QT code corresponding to $L_{5 \text{ and } 2}$ which were shown in drawing 1. $p_{t \text{ and } i}$ are equal to the number of black nodes, and $q_{t \text{ and } i}$ are equivalent to the number of the

nodes of the white in the level i. Speed R_t which must be used supposing direct coding since decomposition of an image is expressed using QT coding, $_bA$ [bit] is as follows.
[0017]
[Equation 4]

$$R_{t,b} = \sum_{i=b+1}^{t} (p_{t,i} + q_{t,i}) = \sum_{i=b+1}^{t} 4p_{t,i+1} = \frac{W \times H}{4^t} + \sum_{i=b+2}^{t} 4p_{t,i} \qquad (4)$$

[0018]54 bits is needed for coding the multilayer display $L_{5 \text{ and } 2}$ which are shown in drawing 1 using QT coding so that drawing 2 may see. This invention makes it possible to display $L_{5 \text{ and } 2}$ in bits fewer than 54 bits.
[0019]In drawing 1, as an edge is shown in this figure, when being extracted, that decomposition process is based only on marginal information. If an edge exists in one block, segment division of the block will be carried out to four child blocks. In this invention, lower-skillful order (that is, segment division leaves the bottom level b) can be used with upper-poor order. As long as an edge and a parameter are constant, even if decomposition of the result adopts which procedure, it is the same.
[0020]Drawing 3 is a block diagram of the encoder concerning one example of this invention. A picture signal inputs into the parameter determination part 1, and is inputted into the marginal extraction part 3 via the image reducing part 2. The marginal extraction part 3 outputs edge data also to the multilayering part 4. The multilayering part 4 multilayers a frame based on the edge data outputted from the marginal extraction part 3. Equal segmentation of the frame is carried out at first with a big block (top level: block of the size specified by t) (this is called the t-th layer), and if a macro edge exists in each block, it will divide into four small blocks (equivalent to the t-1st layer). And it repeats until it results in the layer in which this operation was specified by bottom level:b. The coding part 5 outputs spectral-luminous-efficacy data (Luminosity Data) based on the input and picture signal from the multilayering part 4.
[0021]The function of each block is explained in full detail below.
[0022](1) In the parameter determination parameter determination part 1, the parameter for multilayer display L_t of an input image and b is determined. When d is made into the reduced coefficient carried out as [ize / an input image / by horizontal and vertical both directions / only coefficient-1/-d / aliquot-] using a reduction filter, the value b which is a bottom level is equal to $\log_2 d$, or it is desirable to become larger than it. This is because it is necessary to make pinpointing of a marginal place precise enough in order to guarantee so that it may be suitable for the coding for which the decomposition obtained as a result used the main code-ized process, i.e., the adaptation block in the coding part 5, as the base.
[0023](2) Reduction of an image (Image Decimation)
Applying marginal extraction to the reduced image has an advantage in that the memory spaces for edge data, the complexity of calculation, and image decomposition decrease in number. Speaking of image data especially, when using 1 / 4 size images, i.e., d= 2, edge data can be decreased to one third. Drawing 4 shows the result of the same decomposition using the image to which drawing 1 was reduced as d= 2. in this case, two edges — an association — since it becomes one edge, the data volume of a multilayer display can be generally decreased in a half size compared with a basis (refer to drawing 1). That the number of marginal decreases contributes to reduction of mainly overall data, and change of chord length [as opposed to edge data to this] has little influence on reduction in data. The reduction filter to be used is left to selection of an encoder. This is because great influence does not have a filter in a next process, i.e., marginal extraction.
[0024]In the image reducing part 2, an image is reduced using a desired reduction filter to the multilayer display as which the parameter was determined. It is adapted for the image to which the decomposition process was reduced. The decomposition obtained in this way is actually changed a little. That is, the block of one size [4x4] is remaining as it is (refer to drawing 4).

However, the block of this 4x4 size is [of the whole range of an image] small, or 1% is only occupied, and, for this reason, this difference hardly causes the performance degradation of overall coding.
[0025](3) Marginal extraction [0026]The internal block figure of the marginal extraction part 3 is shown in drawing 5.
[0027]Since a marginal place is traced, the Laplace operator of the common knowledge to the beginning can be applied to the image of a basis (Laplace filter 6), and the binary image showing a position with a large intensity change, i.e., an edge, can be searched for by the threshold operation using mu+K-sigma after that. mu, sigma, and K are the standard deviation and the coefficients of an average and differentiation space here, respectively. As an example, the pattern of the small segment of eight directions is shown in drawing 6, these are expressed by template T_n (n= 0, 1--7), and each entrance (j, k) is expressed with t_n (j, k).
[0028]Subregion within the binary image which comprises 5x5 picture element regions expressed with lambda (x+j, y+k) as j, k= 0, and 1, 2, 3 and 4 is set to lambda (x, y). Template T_n and cross correlation R_n (x, y) between this lambda (x, y) are calculable by the following formula.
[0029]
[Equation 5]

$$R_n(x,y) \doteq \sum_j \sum_k \lambda(j,k)\, t_n(j-x, k-y) \qquad (5)$$

[0030]Then, R_n (x, y) is [eight] equal, or if n which becomes larger than it exists, a flag will be made into quantity in the place of the coordinates (x, y) in n bit plane. n changes from 0 to 7 here. This shows that template T_n was detected as a code pattern with coordinates (x, y). This process must be applied to the whole binary image. In this way, a unit edge is obtained (unit marginal detection 7).
[0031]Next, the macro marginal detection 8 is explained.
[0032]After extracting a unit edge, as shown in drawing 7, detection of a macro edge is performed. A unit edge is connected and it is made 16 directions, i.e., the macro edge defined at intervals of 180 degree/16=11.25 degree. The starting point of detection can be appointed at the pixel on which the flag of the arbitrary bit planes of 8 is acting. If a raster scan type is asked for the point said like this, the search zone connected below a starting point can be localized.
[0033]If it assumes that the starting point where the flag in n bit plane is acting was found, the direction N of a detection process will be defined according to N= 2 n. The next search operation is applied from this direction. Since determining the direction of a macro edge beforehand before a search operation has a risk, the direction which is likely to happen most is chosen from three directions considered, i.e., N, N-1, and N+1. It is determined whether the macro edge is connected in each node (refer to drawing 7) which is in each in accordance with a direction in each direction considered at every unit length L (unit). If the flag is acting in the node or its neighborhood, i.e., eight adjacent pixels, within which [of n, (N-1) / 2, or (N+1) / 2] bit plane, a macro edge will be lengthened till a node. In this way, it is considered as the macro edge which should code a thing long No. 1 among three candidates' called-for macro edges. Once a macro edge is detected, a kind of post-processing for avoiding extracting the same macro edge may be applied. A series of pixels corresponding to eight adjacent pixels in which [of the extracted macro edge and n, (N-1) / 2, or (N+1) / 2] bit plane are made neutrality. This plays the role which attenuates a macro edge and is certainly help reducing the number of the extracted macro edges within an image.
[0034]Next, the intensity collection 9 is explained.
[0035]When performing segment division of a block, it can be considered that the extracted macro edge is important equally, but it is more appropriate to it to attach a grade to them according to ordering on the consciousness which took a certain character of human being's visual system into consideration. Here, Weber's law which stands out much more easily, therefore is made more important than the same luminance change in a high luminance region is

used for the predetermined luminance change in a low luminance area. If it asks for a macro edge, the rectangular area which wraps in a macro edge with certain extension B_{ext} will be appointed as a marginal belt. An example of the marginal belt is shown in drawing 8, and p and q have shown the vertical axis to the axis parallel to a macro edge, and the macro edge in this figure, respectively. In this way, the pixel value in a marginal belt can be expressed with epsilon (p, q).

[0036]Generally, it may be assumed that a actual edge exists along the macro edge in a marginal belt. In order to search for the marginal intensity information drawn from Weber's law, change of gray scale is inspected within each marginal belt. (i) Calculate the average value of a gray level expressed with phi in the whole marginal belt. (ii) From a macro edge, with each vertical axis, find the minimum and greatest gray scale and ask for intensity $delta_0$ of the one lower in this way respectively, and intensity $delta_1$ of the higher one.

[0037]

[Equation 6]

$$\delta_0 = \frac{1}{\tau} \sum_{p=0}^{\tau-1} \min_q \varepsilon(p,q) \qquad (6)$$

[0038]

[Equation 7]

$$\delta_1 = \frac{1}{\tau} \sum_{p=0}^{\tau-1} \max_q \varepsilon(p,q) \qquad (7)$$

tau expresses here the number of pixels which met the axis p in a marginal belt.

[0039]Although the simple example of ****** (step-edge) is shown in drawing 9, in this figure, the place of the actual edge is pursued and expressed as the thick line. Note that a series of pixels which are q= 0 correspond to a macro edge.

[0040]Let F be a gray scale function in the image of a basis. Next, F defines the contrast C which must be significant within a marginal belt.

[0041]

[Equation 8]

C=delta F/F (8)

[0042]a formula (8) uses the statistics called for by the upper calculation to each extracted macro edge -- approximate -- ****** -- things are made.

[0043]

[Equation 9]

$C=(delta_1-delta_0)/phi$ (9)

[0044]According to Weber's law, the surrounding visual sensitivity of a macro edge is proportional to the contrast C defined above. Next, the contrast C introduces the idea of marginal intensity expressed with I_W based on assumption which says that the size of visual sensitivity expresses quantitatively surely.

[0045]

[Equation 10]

$$I_W = \begin{cases} 0 & \theta_0 \le C < \theta_1 \\ 1 & \theta_1 \le C < \theta_2 \\ 2 & \theta_2 \le C < \theta_3 \\ 3 & \theta_3 \le C \end{cases} \qquad (10)$$

[0046]Since importance is inferior, therefore a macro edge [as / the contrast of whose is less than $theta_0$] is considered that importance is inferior for human being's consciousness also for the segment division of an image, removing from edge data is desirable. The marginal intensity can provide the multilayering what is called based on consciousness carried out as [express / with still finer resolution, i.e., a still smaller block, / the surrounding field of the macro edge of

still higher intensity]. Each edge is possible also for realizing the method which enables it to have the thickness of the following according to the intensity value.
[0047]
[Equation 11]
$$太さ = 2 \times I_w + 1 \ (画素) \qquad (11)$$

[0048]Table 1 is a table about the coding message per macro edge. The message about a starting point is further compressible by using a suitable coding mode.
[0049]
[Table 1]

カテゴリ	コード化すべきメッセージ	レンジ	ビット数
ジオメトリック情報	出発点	映像の寸法	Log_2（水平寸法）+ Log_2（垂直寸法）
	縁検出	[0,15]	4
	縁の長さ	[1,32]	可変長コード
縁強度	I_w	[0,3]	2

[0050]An unnecessary macro edge is removed by the multilayering part 4 and the coding part 5 in this example. The multilayering procedure is summarized below.
[0051]In order to change edge data into the quad tree equivalent to it, it searches for existence of the edge within each block simply, and '1' is assigned in the block in which an edge exists, otherwise, '0' is assigned. For example, in the case of the procedure from a top to the bottom, this search operation is applied from the level t even to the level b+1, and the QT code corresponding to the macro edge extracted in this way is obtained. A macro edge will limit decomposition of the QT code, therefore an image uniquely.
[0052]The advantage of this procedure is the level parameters' t and b only being changed, being able to expand resolution so that it may become still finer, or being able to decrease so that it may become still coarser. In other words, various multilayering can be carried out using the same edge data. On the other hand, the decomposition based on a homogeneous test must make the process leave from the start, when a parameter changes. This character has the optimization advantageous to the multiplex path coding process fulfilled repetitively under a certain restraint like the maximum encoded bit speed. That is because the multilayering based on an edge can be performed also after the 2nd path using the edge data extracted with the 1st path.
[0053]In order to evaluate the performance of the method concerning this invention, two kinds of experiments were conducted. One is both method concerning QT coding and this invention, and it is calculating the bit for transmitting a decomposition tree, respectively, and measuring it. The parameter for classifying marginal intensity was set as $theta_0$=0.2, $theta_1$=0.4, $theta_2$=0.8, and $theta_3$=1.6. The bit count to QT coding is based on the formula (4), assuming that the decomposition tree made with this method is obtained. Drawing 10 shows the data speed of the multilayer display in the "flower garden" and the "table tennis" which are the test sequences for MPEG-2 standardization. It is observed that the algorithm of this method always exceeds QT coding in respect of the reduction of data to a multilayer display.
[0054]Another side is a kind of subjective qualification test, and shows the visual effect produced by decomposition based on an edge as compared with the sampling by the block of 8x8 sizes. In both cases, the average luminance value expressed each block. For a fair comparison, the parameter about the classification of marginal intensity was determined experientially and inductively so that the total of the block by this method might approach the number of linearity samplings as much as possible, namely, so that it might become 5,280 blocks. Table 2 shows the statistical result obtained from this experiment. It is observed that this method provides a much more quality image in respect of a peak signal versus noise ratio (PSNR) value.
[0055]
[Table 2]

シーケンス	多層表示	ブロック数				Y-PSNR [dB]
		16x16	8x8	4x4	Total	
フラワー・ガーデン	従来		5280		5280	18.32
	本方式	547	2547	2180	5274	18.56
テーブル・テニス	従来		5280		5280	20.03
	本方式	809	1307	2948	5064	20.53

[0056]It can check decomposing a suitable image for the multilayering method concerning this invention to be comparatively small data volume, and code an image from these two experimental results.
[0057]As mentioned above, although explained per example of this invention, this invention is not restricted to this.
[0058]Below, other inventions are explained. Especially this is related with the decoding method of a variable length code about the control method of an MPEG picture signal.
[0059]When decoding MPEG-2 bit stream, variable length code (VLC) decoding of a DCT coefficient gives restrictions most to the decoding speed of a bit stream. This is because 50%-80% of the coded bit streams are formed with the DCT coefficient. Therefore, efforts to carry out VLC decoding early are made. On the other hand, when the memory space needed takes realization of hardware into consideration, it is another, important factor.
[0060]Decoding of VLC is changing into the original numerical value the binary string who comprises various VLC(s). 1 set of VLC(s) are assembled according to the probability of occurrence of each phenomenon. Namely, the more the probability which a phenomenon has is high, a still shorter code is assigned to the phenomenon and, the more it enables it to stop the average number of bits per code to the minimum. Table 3 shows an example of a VLC table to MPEG-2 DCT coefficient. It is equivalent to finding the code boundary defined as a position between two successive VLC(s) in a binary string to decode a variable length code. As for the conventional VLC decoding method, it was common to have used matching of a bit pattern, although a code boundary is looked for.
[0061]
[Table 3]

可変長コード	ラン (run)	レベル (level)
'10'	End of block	
'11s'	0	1
'011s'	1	1
'0100s'	0	2
'0101s'	2	1
:	:	:
'0000 0000 0001 1100s'	30	1
'0000 0000 0001 1111s'	31	1

注：最後のビット's'はレベルの符号で、正では'0'、負では'1'。

[0062]For example, the mechanism changed into a corresponding DCT coefficient is used for the decoding method considered by the MPEG software-simulation group (MSSG) by reading the binary string of 16 bit length at once, and applying pattern matching of 16 bit length. Although this attains high-speed decoding, since there are not few redundant codes, this mechanism needs a lot of memory space to a DCT coefficient table. 259 of the 432 code items is redundant

and this is actually equivalent to a surprising thing at 60%. This is because linearity operation is used for a VLC decoding method carrying out the address of the related code. Occasionally, memory space may become a conclusive factor when realizing VLC decoding by hardware. This is because it needs for decoding to use an expensive high speed memory.

[0063]This invention provides the VLC decoding method which uses nonlinear map operation (nonlinear mapping operation) instead of matching of a bit pattern. In the decoding method concerning this invention, the step which counts the 0-bit number which continues within the limits of the number of pause Rika predetermined bits in an input bit sequence, and decodes a DCT coefficient using the contents of the status register based on the value which counted [above-mentioned] is included.

[0064]The decoding method containing the step which acquires the contents of the status register via two or more address operations is also indicated.

[0065]One example of this invention is described including theoretical consideration, referring to drawings.

[0066]The VLC decoding method according to this invention is characterized by the nonlinear map operation designed so that what is called self-positioning could be performed. Each operation has bit shift information related so that it can update a current position correctly. Therefore, chord length is not required for a coefficient table. A current position is not necessarily located in the same place as a code boundary, and note that a middle bit position when resuming subsequent operation is only shown. Another point which should be taken into consideration in this method is having to utilize extensively 0 of the DCT coefficient table released by ISO/IEC 13818-2, and the relative redundancy between 1 of a DCT coefficient table. In other words, the coefficient table must be designed so that the scale of the whole table can be reduced, and a redundancy code may be removed. The method concerning one example of this invention is shown in drawing 11.

[0067]Drawing 11 means that decoding of a DCT coefficient is performed in a maximum of four steps, is each first three stages, obtains the information on an input bit sequence one by one using a regular thing among 16 operations of the below-mentioned table 4, and shows that a coefficient is decoded based on those information in the 4th step. Here, it is at the start time, and to define which is used among a zero table or a one table is made into the premise, and this 1 bit information is held as the component X of status register R of the below-mentioned formula (13). The decoding methods differ in a zero table and a one table (procedure is respectively illustrated to drawing 12 and 13).

[0068]When it explains in full detail, a zero table and a one table in the 1st step (block 21). The number of "0" bits which continue within the limits of 6 bits using the operation zero run() of Table 4, from the pause (immediately after [being a bit of the last of the symbolic language which decoding has ended]) in an input bit sequence is counted, and it is held as the component R0 of status register R. And it is bit (R0+1) ****** about the current position in an input bit sequence. In the 2nd step (block 22), processing for which it opts with the value of R0 is performed, and the result is held as R1. In the 3rd step (block 23), processing based on R1 is performed, that result is held as R2, and status register R is obtained at this time. In the 4th step (block 24), a DCT coefficient is decoded from the coefficient table of the below-mentioned table 6 using R.

[0069]In the following explanation, a DCT coefficient is displayed in form (run, level), and a binary string writes in the form called '0010'. Values are decimal values unless it refuses in particular.

[0070]Table 4 describes the map operation which the method concerning this invention uses. 16 map operations occur, nine operations carry out the address of the code among those, it is used for making a decoding process finish after that, and seven operations are returned to the defined value.

[0071]

[Table 4]

記 法	動 作 の 記 述	コード
use_intra_vlc()	マクロブロックが内部符号化されていて、映像層内のintra_ vlc_ formatフラグが同時に立つ時、1に戻る。他の場合、0に戻る。	0000
zero_run()	全部0のストリングの場合、6ビットだけシフトすることを別として、MSBの相次ぐ0のビット長が5ビット以内である時、(戻った値+1)ビットだけシフトする。	0001
one_run()	全部1のストリングの場合、4ビットだけシフトすることを別として、MSBからの相次ぐ1のビット長だけ4ビット以内で戻し、(戻った値+1)ビットだけシフトする。	0010
1st_coef()	問題とする8×8ブロック内で復号された先行する係数がない場合、1に戻る。他の場合、0に戻る。	0011
get_bit(1)	次のビットに戻り、1ビットだけシフトする。	0100
cpm_2bit(0)	次の2ビットが‘00’に等しければ、1に戻り、そうでなければ、0に戻り、1に戻る時だけ2ビットだけシフトする。	0101
cpm_2bit(2)	次の2ビットが‘10’に等しい場合、1に戻り、そうでない場合、0に戻り、1に戻る時だけ、2ビットだけシフトする。	0110
term_#0()	M(R,1)によってアドレスされた係数で終了する。	0111
term_#1()	M(R,2)でアドレスされた係数で終了する。	1000
term_#2()	M(R,3)でアドレスされた係数で終了する。	1001
term_#3()	M(R,4)でアドレスされた係数で終了する。	1010
term_#4()	escape_ codeシンタクスによる係数で終了する。	1011
term_#5()	係数(R_0,R_1)で終了する。	1100
term_#6()	係数(0,R_1+1)で終了する。	1101
term_#7()	係数(1,1)で終了する。	1111
term_#8()	係数(0,0)で終了する。	1110
注	MSB:最上位ビット	

[0072]In Table 4, M (R, n) (n= 1, 2, 3, 4 ....) is a mapping function defined as follows.
[0073]
[Equation 12]
M(R,n)=Table [R][getbit (n)] (12)
[0074]R is eight bit registers defined by the following form here.
Semantics is shown in Table 5.
This is named a status register. get-bit (n) is a function to which the decimal values of the following n bit are returned, and only n bit is shifted.
[0075]
[Equation 13]
R**X;R0;R1;R2 (13)
[0076]
[Table 5]

成 分	成 分 の 記 述	必要なビット数
X	intra_ vlc_ formatに相当する。	1
R_0	#1アドレスオペレーションから戻った値を記憶する。	3
R_1	#2アドレスオペレーションから戻った値を記憶する。	3
R_2	#3アドレスオペレーションから戻った値を記憶する。	1
注	全てのレジスタ成分が、係数を復号する前に0にリセットする。	

[0077]C source language can describe operation term-#4 (), i.e., escape-code, as follows.
[0078]
[Equation 14]

```
term_#4()
{
      run=get_bit( 6 );
      if(MPEG-2){ /* MPEG-2 stream */
            level=-2048*get_bit( 1 );
            level=level+get_bit( 11 );
      }
      else{ /* MPEG-1 stream */
            index=get_bit( 8 );
            if( index==0x00 ) /* level>=128, 28bit-code */                    (14)
                  level=get_bit( 8 );
            else if( index==0x80  ) /* level<=-128, 28bit-code */
                  level=get_bit( 8 )-256;
            else{ /* abs(level)<128 */
                  if( (index>>7)==0 ) /* level>=1, 20bit-code */
                        level=index;
                  else
                        level=(index&0x7f)-128;
            }
      }
}
```

[0079]Here, the coefficient table used for the method concerning this invention is defined. In this case, each code is accessed as an item of a two dimensional array. For example, [0;0;0;0] [0] is equivalent to (N/A, EOB).

[0080]

[Table 6]

R	テーブル〔R〕の内容
0;0;0;0	(N/A,EOB), (0,1)
0;1;0;0	(0,2), (2,1)
0;2;0;0	(N/A,N/A), (0,3), (4,1), (3,1)
0;2;1;0	(13,1), (0,6), (12,1), (11,1), (3,2), (1,3), (0,5), (10,1)
0;3;0;0	(7,1), (6,1), (1,2), (5,1)
0;4;0;0	(2,2), (9,1), (0,4), (8,1)
0;6;0;0	(16,1), (5,2), (0,7), (2,3), (1,4), (15,1), (14,1), (4,2)
0;6;1;0	(0,11), (8,2), (4,3), (0,10), (2,4), (7,2), (21,1), (20,1), (0,9), (19,1), (18,1), (1,5), (3,3), (0,8), (6,2), (17,1)
0;6;2;0	(10,2), (9,2), (5,3), (3,4), (2,5), (1,7), (1,6), (0,15), (0,14), (0,13), (0,12), (26,1), (25,1), (24,1), (23,1), (22,1)
0;6;3;0	(0,31), (0,30), (0,29), (0,28), (0,27), (0,26), (0,25), (0,24), (0,23), (0,22), (0,21), (0,20), (0,19), (0,18), (0,17), (0,16)
0;6;4;0	(0,40), (0,39), (0,38), (0,37), (0,36), (0,35), (0,34), (0,33), (0,32), (1,14), (1,13), (1,12), (1,11), (1,10), (1,9), (1,8)
0;6;5;0	(1,18), (1,17), (1,16), (1,15), (6,3), (16,2), (15,2), (14,2), (13,2), (12,2), (11,2), (31,1), (30,1), (29,1), (28,1), (27,1)
1;0;2;0	(0,4), (0,5)
1;0;3;0	(9,1), (1,3), (10,1), (0,8)
1;0;4;0	(0,9), (N/A,N/A), (0,12), (0,13), (2,3), (4,2), (0,14), (0,15)
1;1;1;0	(N/A,EOB), (0,3)
1;2;1;0	(1,5), (11,1), (0,11), (0,10), (13,1), (12,1), (3,2), (1,4)
1;2;0;0	(N/A,N/A), (2,1), (1,2), (3,1)
1;3;0;0	(0,7), (0,6), (4,1), (5,1)
1;4;0;0	(7,1), (8,1), (6,1), (2,2)
1;6;0;1	(2,4), (16,1)
1;6;0;0	(5,2), (14,1), (N/A,N/A), (15,1)
Note	EOB: End of block, N/A: Not applicable

[0081]Drawing 12 shows the decoding algorithm concerning one example of this invention, and shows the VLC decoding algorithm which has such operations when not acting, the case of 0, i.e., intra-vlc-format, of a DCT coefficient table. In this figure, R0 and R1 are calculated and this corresponds to the 1st address operation (block 21) and the 2nd address operation (block 22) in the block diagram of drawing 11. This process does not cover a sign bit. This is because it can treat easily if other precedence portions of VLC are known. This algorithm shows the decoding process of one code. However, it can be jumped over the first judgment routine, i.e., use-intra-vlc(). It is because the value to which this returned while image layer syntax intra-vlc-format was not acting is being fixed to 0. Therefore, in the state of saying like this, it can start from the next operation, i.e., zero-run(), and a decoding process sets X to 0 compulsorily. Before status register R applies use-intra-vlc(), it should still be reset to 0; 0; 0; 0.

[0082]When intra-vlc-format is acting, another algorithm shown in drawing 13 is used. In this figure, R0, R1, and R2 are calculated, and this corresponds to the 1st operation (block 21) in a block diagram, the 2nd operation (block 22), and the 3rd operation (block 23) of drawing 11.

[0083]As shown [drawing 13 / drawing 12 and] in drawing 11, in order to decode a coefficient except for operation use-intra-vlc(), it turns out that the VLC decoding method concerning this invention needs at most three address operations.

[0084]Table 7 shows an example of a VLC decoding process when a binary string '00100010' appears. It is a table as a decoding result. [0;2;1;0] It is shown that [2] is obtained. That is, a

binary string '00100010' corresponds to a code (12, 1). The vertical bar between the bits shown in the column of the "current position" of Table 7 shows the pause (pause which makes a unit operation which is not a pause of a symbolic language and starts this invention) of a bit string. In the example of Table 7, the input bit sequence is flowing into the left from the right, information is already extracted from there and the bit string which is on the left of a pause is regarded as data which does not have on future decoding processing.
[0085]
[Table 7]

プロセス段階	適用するオペレーション	戻る値/係数	$X;R_0;R_1;R_2$	現在位置
			0;0;0;0	|00100010
#1オペレーション	zero_run()			
		2	0;2;0;0	001|00010
#2オペレーション	cpn_2bit(0)			
		1	0;2;1;0	00100|010
#3オペレーション	term_#2()			
		[R] [2]	0;2;1;0	00100010|

[0086]It is verified by the simulation that the method concerning this invention decodes a DCT coefficient correctly from coded various bit strings.
[0087]This method enables 154 coefficient code **** VLC decodings (42 pieces receiving 1 of a DCT coefficient table to 0 of a DCT coefficient table 112 pieces) as well as the case of reduction of the scale of a table. On the other hand, 432 coefficient codes are used for the decoding method considered by the MPEG software-simulation group (MSSG). For a precise comparison, Table 8 is the number of bits taken to express a code item to each method, and shows the format of the coefficient table. Eventually, the scales of a table are 1,694 bits (154x11) and 6,912 bits (432x16) to the method and MSSG decoding method which start this invention, respectively. When the ratio is said roughly, it is equal to 4:1.
[0088]
[Table 8]

方　式	データ	範囲（10進）	必要なビット数	必要なビット数の総計
MSSG	ラン (run)	0−31, EOB, ESCAPE	6	16ビット/コード
	レベル(level)	1−40	6	
	コード長	1−16	4	
本発明	ラン (run)	0−31	5	11ビット/コード
	レベル(level)	1−40, EOB, ESCAPE	6	
注：ESCAPEは、escape_code シンタクスに従って扱わなければならないことを意味する。				

[0089]Speaking of a bus architecture, a MSSG decoding method needs an 8-bit address bus. This is because the maximal term number of division of a coefficient table is 250. On the other hand, in the method concerning this invention as shown in Table 6, a 4-bit address bus is enough.
[0090]As mentioned above, since decoding can be advanced acquiring the information (status register) for decoding for every stage, and updating a current position, the field which expresses code length to the coefficient table referred to eventually becomes unnecessary, and only the part can reduce a coefficient table. Since the address bit length at the time of furthermore referring to a coefficient table is made to 4 bits to 8 bits of the former (MSSG), the number of entries of a coefficient table can be reduced by half. A coefficient table is made into conventional 1/3 thru/or 1/4 by these two effects.
[0091]Another invention is explained below. This invention relates to the motion compensation of a video picture signal. In the coding mode using the conventional motion compensation, the

unit. In recent years, the method which performs a motion compensation by the block unit of variable size as shown in drawing 14 as what improved this is examined. By this technique, a frame is divided into a small block in homogeneous fields, such as a background, near the object again at a big block. The purpose is to transmit motion information finely near the object which an error tends to generate, and is controlling the error generated with the whole frame. However, in this variable size-block motion compensation, when the information for block division is transmitted by the data of a tree structure for 4 minutes, the problem that an overhead becomes large to the profit of coding is pointed out. So, in the proposal technique, in order to reduce this overhead, variable size-block division is performed by extracting and transmitting edge information. That is, the proposal technique is a motion compensation coding mode characterized by the variable size-block division based on edge.

[0092]By the edge extraction by pursuit of the pixel unit used from the former, since the amount of information of an overhead becomes large, in order to prevent this, by the proposal technique, the method of expressing edge approximately not by a point but by a line segment is adopted. The functional block diagram of a block division algorithm is shown in drawing 15.

[0093]First, the break point of a luminance change is extracted by covering a secondary differentiation filter over an original image (or decoding frame). And two steps of grouping processings are performed to a set of the point (it is called an edge point) acquired by the threshold process, and the line segment expressing objective shape is extracted. In the 1st-step grouping processing, the line segment (it is called a unit line segment) which had deed directivity for template matching of a set of an edge point and the line segment pattern mask with a size of 5x5 pixels quantized in the eight directions is extracted (block 61). This is extraction of a unit line segment.

[0094]Next, extraction (block 62) of a macro line segment is explained. Since human being's visual center cell has the character (this is called orientation selectivity) to react per 10 degrees to rotation of an object, in the 2nd-step county-ized processing, it combines the unit line segment which follows a uniform direction, and extracts the line segment (it is called a macro line segment) quantized in the 16 directions. The example of a macro line segment is as being shown in drawing 16. The data format expressing a macro line segment is the two-dimensional coordinates, the direction (the one direction of the inside quantized to 16), and length (joint pixel number) of a corner point of each line segment.

[0095]And in block division (block 63), equal segmentation of the frame is carried out with a big block (the permission maximum block) at first (this is called the 1st layer), and if a macro line segment exists in each block, it will divide into four small blocks (this is called the 2nd layer). And it repeats until it obtains the permission minimum block which specified this operation beforehand. In block division of drawing 16, from the 1st layer to the 3rd layer exists.

[0096]It did not depend for the amount of information of the overhead on the contents of the picture from an old experimental result, but when it was division up to the 2nd layer, when the proposal technique and a 4-minute tree structure were equivalent and the 3rd more than layer mostly, they checked the thing with few (it is got blocked and is advantageous) proposal techniques. Although the block shown by the drawing 14 destructive line usually performs edge extraction on an original image by the proposal technique, it shows that there is a method of using as an alternative the frame decoded before. In this alternative, since a decoding frame equal in both the local decoding-ized part [by the side of coding] and decryption sides exists, it uses that the edge which will be obtained if the edge extraction method is the same also becomes equal. I hear that the overhead of the advantage of this technique is lost, and there is. However, since it is premised on the decoding frame and the frame actually processed being similar, when a difference arises to both, mistaken division will be performed and encoding efficiency falls. Therefore, the mechanism which switches the case where the case where an original image is used, and a decoding frame are used, accommodative is needed.

[0097]

[Effect of the Invention]A suitable image to code an image can be decomposed with smaller data volume.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application]This invention relates to the encoding method of a picture, especially the encoding method of a compressed image.

[Translation done.]

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TECHNICAL PROBLEM

[Description of the Prior Art]A multilayer method is an easy method for obtaining the image display with the field of a different size. The tree (tree) which is useful to coding of an image, especially compression of the image through progress transmission (progressive transmission) as for this display, and is obtained as a result, Quad tree (quadtree) coding (E. "Image compression via improved quadtree decomposition algorithm"IEEE written by M.Feder.) [Shusterman and] Usually it transmits using [Trans.Image Processing, vol.3, no.2, pp207-215-1944, and else].
[0003]A natural image can be divided into the field of a different size with the details and the information on variable quantity. Such segment division of an image is preferred because of the coding with the sufficient efficiency of image data. Quad tree (QT) coding is the main methods showing decomposition of an image, i.e., multilayering.
An image is divided into the rectangular region where two dimensions are homogeneous (homogenous).
The decomposition builds a tree, and each node of a tree has four children, and it relates to the field to which the image was limited uniquely. A root relates to the whole image. When using QT coding for compression of an image, it is required to code the tree obtained as a result. A coding procedure includes coding of coding of tree structure information, and a node / leaf information, i.e., a segment division flag. The parameter which describes the intensity of a corresponding partial image (subimage) is assigned to each leaf. Of course, the pixel of an image will be a leaf whenever it appears in the QT code. Coding of the tree structure should be completed with the level under No. 1, i.e., the level in front of [of a block of the lower limit which can be permitted] one, and this block must be equal to a pixel, or must be larger than it.
[0004]However, QT coding is not utilizing the useful character. A certain block has the still larger likelihood divided into a regional block, when an adjoining block is divided. A background is explained by the fact which comprises a much more big block to the image with this natural character being a thing describing a certain object which should express using a continuous small block. In other words, further compressible spatial relative redundancy exists in the QT code. This means that an image can be decomposed still more efficiently than QT coding by using the technique of expressing an object briefly. There is marginal (edge) information as one of some the candidates for displaying an object. In one method using marginal information, an edge is extracted with a line approximating method (hierarchy form marginal detection). Therefore, although decomposition of an image is carried out based on an edge existing in each block and is useful in the scene of a simple object like the image of the head and a shoulder, it is a difficulty that a redundant overhead, i.e., an edge, causes encoding efficiency lower than QT coding.

[Translation done.]

OPERATION

[Means for Solving the Problem and its Function]In this invention, a multilayering method (Multilayering Scheme) with which it was improved for coding of an image is provided. It is not necessary to code an edge in accuracy of a pixel, and since what is necessary is just the accuracy of a block level small No. 1 in the case of segment division, marginal extraction can be performed by a reduced image (decimated image). Edge data can also be reduced with complexity of calculation memory space and for marginal extraction, attaining suitable multilayering then.
[0006]An encoding method of this invention determines a parameter for a multilayer display of an input image, An image is reduced using a desired reduction filter to a multilayer display as which a parameter was determined, In order to look for a marginal place to a reduced image, Laplace operation is performed and a step which wraps in a macro edge which detected and detected a macro edge based on a unit edge which detected and detected a unit edge and which computes marginal intensity for every rectangular area is included.

[Translation done.]

EXAMPLE

[Example]One example including the theoretical consideration which resulted in this invention is described with reference to drawings.
[0008]Quad tree coding is explained below first.
[0009]$L_{t \text{ and } b}$ are considered as the multilayer display of an image. t and b are the parameters showing a top level and a bottom level, respectively, and are T>b>=0 here. This time $L_{t \text{ and } b}$ are defined as follows.
[0010]
[Equation 1]

$$L_{t,b} = \{l_{t,t} \cup l_{t,t-1} \cup \cdots \cup l_{t,i} \cup \cdots \cup l_{t,b+1} \cup l_{t,b}\} \quad (1)$$

$l_{t \text{ and } i}$ are the layers which comprised a block of the size of $2^i x 2^i$, and it means that a decomposition process leaves on the level t and finishes this with the level i about the block.
[0011]Next, a variable is defined. $p_{t \text{ and } i}$ are the number of the blocks of the size of $2^i x 2^i$ divided into four subblocks with the level i−1 low next, i.e., a level.
$q_{t \text{ and } i}$ are the number of the blocks of the size of $2^i x 2^i$ which remains with the same size also below the level i−1, and, for this reason, the block corresponding to this $q_{t \text{ and } i}$ constitutes $1_{t \text{ and } i}$.
It assumes that the size of an input image is a pixel of W(width) xH (height), and the layer of the pixel of an image is expressed as the level 0. The relation between two variables is then expressed by the repetitive equation.
[0012]
[Equation 2]

$$\begin{aligned} p_{t,i} + q_{t,i} &= 4p_{t,i+1} \\ p_{t,t+1} &= W \times H / 4^{t+1} \end{aligned} \quad (2)$$

[0013]t fulfills the following conditions.
[0014]
[Equation 3]

$$W \ mod \ 2^t = 0 \ and \ H \ mod \ 2^t = 0 \quad (3)$$

[0015]An example of the multilayer display at the time of being t= 5 and b= 2 as a parameter is shown in drawing 1 in which two bridle wires exist.
[0016]As for an order of coding with each level, a little unlike the case of a square image, the block of the same size becomes an order of a raster scan type. that is, it comes out from the right and a top downward from the left. '1' is assigned to parents' node and '0' is assigned to a leaf. Drawing 2 shows the QT code corresponding to $L_{5 \text{ and } 2}$ which were shown in drawing 1. p_t are equal to the number of black nodes, and q are equivalent to the number of the

nodes of the white in the level i. Speed $R_{t \text{ which must be used supposing direct coding since decomposition of an image is expressed using QT coding}, b}$A [bit] is as follows.
[0017]
[Equation 4]

$$R_{t,b} = \sum_{i=b+1}^{t} (p_{t,i} + q_{t,i}) = \sum_{i=b+1}^{t} 4p_{t,i+1} = \frac{W \times H}{4^t} + \sum_{i=b+2}^{t} 4p_{t,i} \qquad (4)$$

[0018]54 bits is needed for coding the multilayer display $L_{5 \text{ and } 2}$ which are shown in drawing 1 using QT coding so that drawing 2 may see. This invention makes it possible to display $L_{5 \text{ and } 2}$ in bits fewer than 54 bits.
[0019]In drawing 1, as an edge is shown in this figure, when being extracted, that decomposition process is based only on marginal information. If an edge exists in one block, segment division of the block will be carried out to four child blocks. In this invention, lower-skillful order (that is, segment division leaves the bottom level b) can be used with upper-poor order. As long as an edge and a parameter are constant, even if decomposition of the result adopts which procedure, it is the same.
[0020]Drawing 3 is a block diagram of the encoder concerning one example of this invention. A picture signal inputs into the parameter determination part 1, and is inputted into the marginal extraction part 3 via the image reducing part 2. The marginal extraction part 3 outputs edge data also to the multilayering part 4. The multilayering part 4 multilayers a frame based on the edge data outputted from the marginal extraction part 3. Equal segmentation of the frame is carried out at first with a big block (top level: block of the size specified by t) (this is called the t-th layer), and if a macro edge exists in each block, it will divide into four small blocks (equivalent to the t-1st layer). And it repeats until it results in the layer in which this operation was specified by bottom level:b. The coding part 5 outputs spectral-luminous-efficacy data (Luminosity Data) based on the input and picture signal from the multilayering part 4.
[0021]The function of each block is explained in full detail below.
[0022](1) In the parameter determination parameter determination part 1, the parameter for multilayer display $L_{t \text{ of an input image and } b}$ is determined. When d is made into the reduced coefficient carried out as [ize / an input image / by horizontal and vertical both directions / only coefficient-1/-d / aliquot-] using a reduction filter, the value b which is a bottom level is equal to $\log_2 d$, or it is desirable to become larger than it. This is because it is necessary to make pinpointing of a marginal place precise enough in order to guarantee so that it may be suitable for the coding for which the decomposition obtained as a result used the main code-ized process, i.e., the adaptation block in the coding part 5, as the base.
[0023](2) Reduction of an image (Image Decimation)
Applying marginal extraction to the reduced image has an advantage in that the memory spaces for edge data, the complexity of calculation, and image decomposition decrease in number. Speaking of image data especially, when using 1 / 4 size images, i.e., d= 2, edge data can be decreased to one third. Drawing 4 shows the result of the same decomposition using the image to which drawing 1 was reduced as d= 2. in this case, two edges -- an association -- since it becomes one edge, the data volume of a multilayer display can be generally decreased in a half size compared with a basis (refer to drawing 1). That the number of marginal decreases contributes to reduction of mainly overall data, and change of chord length [as opposed to edge data to this] has little influence on reduction in data. The reduction filter to be used is left to selection of an encoder. This is because great influence does not have a filter in a next process, i.e., marginal extraction.
[0024]In the image reducing part 2, an image is reduced using a desired reduction filter to the multilayer display as which the parameter was determined. It is adapted for the image to which the decomposition process was reduced. The decomposition obtained in this way is actually changed a little. That is, the block of one size [4x4] is remaining as it is (refer to drawing 4).

However, the block of this 4x4 size is [of the whole range of an image] small, or 1% is only occupied, and, for this reason, this difference hardly causes the performance degradation of overall coding.
[0025](3) Marginal extraction [0026]The internal block figure of the marginal extraction part 3 is shown in drawing 5.
[0027]Since a marginal place is traced, the Laplace operator of the common knowledge to the beginning can be applied to the image of a basis (Laplace filter 6), and the binary image showing a position with a large intensity change, i.e., an edge, can be searched for by the threshold operation using mu+K-sigma after that. mu, sigma, and K are the standard deviation and the coefficients of an average and differentiation space here, respectively. As an example, the pattern of the small segment of eight directions is shown in drawing 6, these are expressed by template T_n (n= 0, 1—7), and each entrance (j, k) is expressed with t_n (j, k).
[0028]Subregion within the binary image which comprises 5x5 picture element regions expressed with lambda (x+j, y+k) as j, k= 0, and 1, 2, 3 and 4 is set to lambda (x, y). Template T_n and cross correlation R_n (x, y) between this lambda (x, y) are calculable by the following formula.
[0029]
[Equation 5]
$$R_n(x,y) \doteq \sum_j \sum_k \lambda(j,k)\, t_n(j-x, k-y) \qquad (5)$$
[0030]Then, R_n (x, y) is [eight] equal, or if n which becomes larger than it exists, a flag will be made into quantity in the place of the coordinates (x, y) in n bit plane. n changes from 0 to 7 here. This shows that template T_n was detected as a code pattern with coordinates (x, y). This process must be applied to the whole binary image. In this way, a unit edge is obtained (unit marginal detection 7).
[0031]Next, the macro marginal detection 8 is explained.
[0032]After extracting a unit edge, as shown in drawing 7, detection of a macro edge is performed. A unit edge is connected and it is made 16 directions, i.e., the macro edge defined at intervals of 180 degree/16=11.25 degree. The starting point of detection can be appointed at the pixel on which the flag of the arbitrary bit planes of 8 is acting. If a raster scan type is asked for the point said like this, the search zone connected below a starting point can be localized.
[0033]If it assumes that the starting point where the flag in n bit plane is acting was found, the direction N of a detection process will be defined according to N= 2 n. The next search operation is applied from this direction. Since determining the direction of a macro edge beforehand before a search operation has a risk, the direction which is likely to happen most is chosen from three directions considered, i.e., N, N-1, and N+1. It is determined whether the macro edge is connected in each node (refer to drawing 7) which is in each in accordance with a direction in each direction considered at every unit length L (unit). If the flag is acting in the node or its neighborhood, i.e., eight adjacent pixels, within which [of n, (N-1) / 2, or (N+1) / 2] bit plane, a macro edge will be lengthened till a node. In this way, it is considered as the macro edge which should code a thing long No. 1 among three candidates' called-for macro edges. Once a macro edge is detected, a kind of post-processing for avoiding extracting the same macro edge may be applied. A series of pixels corresponding to eight adjacent pixels in which [of the extracted macro edge and n, (N-1) / 2, or (N+1) / 2] bit plane are made neutrality. This plays the role which attenuates a macro edge and is certainly help reducing the number of the extracted macro edges within an image.
[0034]Next, the intensity collection 9 is explained.
[0035]When performing segment division of a block, it can be considered that the extracted macro edge is important equally, but it is more appropriate to it to attach a grade to them according to ordering on the consciousness which took a certain character of human being's visual system into consideration. Here, Weber's law which stands out much more easily, therefore is made more important than the same luminance change in a high luminance region is

used for the predetermined luminance change in a low luminance area. If it asks for a macro edge, the rectangular area which wraps in a macro edge with certain extension B_{ext} will be appointed as a marginal belt. An example of the marginal belt is shown in drawing 8, and p and q have shown the vertical axis to the axis parallel to a macro edge, and the macro edge in this figure, respectively. In this way, the pixel value in a marginal belt can be expressed with epsilon (p, q).

[0036]Generally, it may be assumed that a actual edge exists along the macro edge in a marginal belt. In order to search for the marginal intensity information drawn from Weber's law, change of gray scale is inspected within each marginal belt. (i) Calculate the average value of a gray level expressed with phi in the whole marginal belt. (ii) From a macro edge, with each vertical axis, find the minimum and greatest gray scale and ask for intensity $delta_0$ of the one lower in this way respectively, and intensity $delta_1$ of the higher one.

[0037]

[Equation 6]

$$\delta_0 = \frac{1}{\tau} \sum_{p=0}^{\tau-1} \min_q \varepsilon(p,q) \qquad (6)$$

[0038]

[Equation 7]

$$\delta_1 = \frac{1}{\tau} \sum_{p=0}^{\tau-1} \max_q \varepsilon(p,q) \qquad (7)$$

tau expresses here the number of pixels which met the axis p in a marginal belt.

[0039]Although the simple example of ****** (step-edge) is shown in drawing 9, in this figure, the place of the actual edge is pursued and expressed as the thick line. Note that a series of pixels which are q= 0 correspond to a macro edge.

[0040]Let F be a gray scale function in the image of a basis. Next, F defines the contrast C which must be significant within a marginal belt.

[0041]

[Equation 8]

C=delta F/F (8)

[0042]a formula (8) uses the statistics called for by the upper calculation to each extracted macro edge -- approximate -- ****** -- things are made.

[0043]

[Equation 9]

C=($delta_1$-$delta_0$)/phi (9)

[0044]According to Weber's law, the surrounding visual sensitivity of a macro edge is proportional to the contrast C defined above. Next, the contrast C introduces the idea of marginal intensity expressed with I_W based on assumption which says that the size of visual sensitivity expresses quantitatively surely.

[0045]

[Equation 10]

$$I_w = \begin{cases} 0 & \theta_0 \le C < \theta_1 \\ 1 & \theta_1 \le C < \theta_2 \\ 2 & \theta_2 \le C < \theta_3 \\ 3 & \theta_3 \le C \end{cases} \qquad (10)$$

[0046]Since importance is inferior, therefore a macro edge [as / the contrast of whose is less than $theta_0$] is considered that importance is inferior for human being's consciousness also for the segment division of an image, removing from edge data is desirable. The marginal intensity can provide the multilayering what is called based on consciousness carried out as [express / with still finer resolution, i.e., a still smaller block, / the surrounding field of the macro edge of

still higher intensity]. Each edge is possible also for realizing the method which enables it to have the thickness of the following according to the intensity value.
[0047]
[Equation 11]
$$太さ = 2 \times I_w + 1 \text{（画素）} \qquad (11)$$

[0048]Table 1 is a table about the coding message per macro edge. The message about a starting point is further compressible by using a suitable coding mode.
[0049]
[Table 1]

カテゴリ	コード化すべきメッセージ	レンジ	ビット数
ジオメトリック情報	出発点	映像の寸法	Log_2（水平寸法）+ Log_2（垂直寸法）
	縁検出	[0,15]	4
	縁の長さ	[1,32]	可変長コード
縁強度	I_w	[0,3]	2

[0050]An unnecessary macro edge is removed by the multilayering part 4 and the coding part 5 in this example. The multilayering procedure is summarized below.
[0051]In order to change edge data into the quad tree equivalent to it, it searches for existence of the edge within each block simply, and '1' is assigned in the block in which an edge exists, otherwise, '0' is assigned. For example, in the case of the procedure from a top to the bottom, this search operation is applied from the level t even to the level b+1, and the QT code corresponding to the macro edge extracted in this way is obtained. A macro edge will limit decomposition of the QT code, therefore an image uniquely.
[0052]The advantage of this procedure is the level parameters' t and b only being changed, being able to expand resolution so that it may become still finer, or being able to decrease so that it may become still coarser. In other words, various multilayering can be carried out using the same edge data. On the other hand, the decomposition based on a homogeneous test must make the process leave from the start, when a parameter changes. This character has the optimization advantageous to the multiplex path coding process fulfilled repetitively under a certain restraint like the maximum encoded bit speed. That is because the multilayering based on an edge can be performed also after the 2nd path using the edge data extracted with the 1st path.
[0053]In order to evaluate the performance of the method concerning this invention, two kinds of experiments were conducted. One is both method concerning QT coding and this invention, and it is calculating the bit for transmitting a decomposition tree, respectively, and measuring it. The parameter for classifying marginal intensity was set as $theta_0$=0.2, $theta_1$=0.4, $theta_2$=0.8, and $theta_3$=1.6. The bit count to QT coding is based on the formula (4), assuming that the decomposition tree made with this method is obtained. Drawing 10 shows the data speed of the multilayer display in the "flower garden" and the "table tennis" which are the test sequences for MPEG-2 standardization. It is observed that the algorithm of this method always exceeds QT coding in respect of the reduction of data to a multilayer display.
[0054]Another side is a kind of subjective qualification test, and shows the visual effect produced by decomposition based on an edge as compared with the sampling by the block of 8x8 sizes. In both cases, the average luminance value expressed each block. For a fair comparison, the parameter about the classification of marginal intensity was determined experientially and inductively so that the total of the block by this method might approach the number of linearity samplings as much as possible, namely, so that it might become 5,280 blocks. Table 2 shows the statistical result obtained from this experiment. It is observed that this method provides a much more quality image in respect of a peak signal versus noise ratio (PSNR) value.
[0055]

シーケンス	多層表示	ブロック数				Y-PSNR [dB]
		16x16	8x8	4x4	Total	
フラワー・ガーデン	従来		5280		5280	18.32
	本方式	547	2547	2180	5274	18.56
テーブル・テニス	従来		5280		5280	20.03
	本方式	809	1307	2948	5064	20.53

[0056]It can check decomposing a suitable image for the multilayering method concerning this invention to be comparatively small data volume, and code an image from these two experimental results.
[0057]As mentioned above, although explained per example of this invention, this invention is not restricted to this.
[0058]Below, other inventions are explained. Especially this is related with the decoding method of a variable length code about the control method of an MPEG picture signal.
[0059]When decoding MPEG-2 bit stream, variable length code (VLC) decoding of a DCT coefficient gives restrictions most to the decoding speed of a bit stream. This is because 50%-80% of the coded bit streams are formed with the DCT coefficient. Therefore, efforts to carry out VLC decoding early are made. On the other hand, when the memory space needed takes realization of hardware into consideration, it is another, important factor.
[0060]Decoding of VLC is changing into the original numerical value the binary string who comprises various VLC(s). 1 set of VLC(s) are assembled according to the probability of occurrence of each phenomenon. Namely, the more the probability which a phenomenon has is high, a still shorter code is assigned to the phenomenon and, the more it enables it to stop the average number of bits per code to the minimum. Table 3 shows an example of a VLC table to MPEG-2 DCT coefficient. It is equivalent to finding the code boundary defined as a position between two successive VLC(s) in a binary string to decode a variable length code. As for the conventional VLC decoding method, it was common to have used matching of a bit pattern, although a code boundary is looked for.
[0061]
[Table 3]

可変長コード	ラン (run)	レベル (level)
'10'	End of block	
'11s'	0	1
'011s'	1	1
'0100s'	0	2
'0101s'	2	1
	:	
	:	
	:	
'0000 0000 0001 1100s'	30	1
'0000 0000 0001 1111s'	31	1
注：最後のビット's'はレベルの符号で、正では'0'、負では'1'。		

[0062]For example, the mechanism changed into a corresponding DCT coefficient is used for the decoding method considered by the MPEG software-simulation group (MSSG) by reading the binary string of 16 bit length at once, and applying pattern matching of 16 bit length. Although this attains high-speed decoding, since there are not few redundant codes, this mechanism needs a lot of memory space to a DCT coefficient table. 259 of the 432 code items is redundant

and this is actually equivalent to a surprising thing at 60%. This is because linearity operation is used for a VLC decoding method carrying out the address of the related code. Occasionally, memory space may become a conclusive factor when realizing VLC decoding by hardware. This is because it needs for decoding to use an expensive high speed memory.

[0063]This invention provides the VLC decoding method which uses nonlinear map operation (nonlinear mapping operation) instead of matching of a bit pattern. In the decoding method concerning this invention, the step which counts the 0-bit number which continues within the limits of the number of pause Rika predetermined bits in an input bit sequence, and decodes a DCT coefficient using the contents of the status register based on the value which counted [above-mentioned] is included.

[0064]The decoding method containing the step which acquires the contents of the status register via two or more address operations is also indicated.

[0065]One example of this invention is described including theoretical consideration, referring to drawings.

[0066]The VLC decoding method according to this invention is characterized by the nonlinear map operation designed so that what is called self-positioning could be performed. Each operation has bit shift information related so that it can update a current position correctly. Therefore, chord length is not required for a coefficient table. A current position is not necessarily located in the same place as a code boundary, and note that a middle bit position when resuming subsequent operation is only shown. Another point which should be taken into consideration in this method is having to utilize extensively 0 of the DCT coefficient table released by ISO/IEC 13818-2, and the relative redundancy between 1 of a DCT coefficient table. In other words, the coefficient table must be designed so that the scale of the whole table can be reduced, and a redundancy code may be removed. The method concerning one example of this invention is shown in drawing 11.

[0067]Drawing 11 means that decoding of a DCT coefficient is performed in a maximum of four steps, is each first three stages, obtains the information on an input bit sequence one by one using a regular thing among 16 operations of the below-mentioned table 4, and shows that a coefficient is decoded based on those information in the 4th step. Here, it is at the start time, and to define which is used among a zero table or a one table is made into the premise, and this 1 bit information is held as the component X of status register R of the below-mentioned formula (13). The decoding methods differ in a zero table and a one table (procedure is respectively illustrated to drawing 12 and 13).

[0068]When it explains in full detail, a zero table and a one table in the 1st step (block 21). The number of "0" bits which continue within the limits of 6 bits using the operation zero run() of Table 4, from the pause (immediately after [being a bit of the last of the symbolic language which decoding has ended]) in an input bit sequence is counted, and it is held as the component R0 of status register R. And it is bit (R0+1) ****** about the current position in an input bit sequence. In the 2nd step (block 22), processing for which it opts with the value of R0 is performed, and the result is held as R1. In the 3rd step (block 23), processing based on R1 is performed, that result is held as R2, and status register R is obtained at this time. In the 4th step (block 24), a DCT coefficient is decoded from the coefficient table of the below-mentioned table 6 using R.

[0069]In the following explanation, a DCT coefficient is displayed in form (run, level), and a binary string writes in the form called '0010'. Values are decimal values unless it refuses in particular.

[0070]Table 4 describes the map operation which the method concerning this invention uses. 16 map operations occur, nine operations carry out the address of the code among those, it is used for making a decoding process finish after that, and seven operations are returned to the defined value.

[0071]

[Table 4]

記 法	動 作 の 記 述	コード
use_intra_vlc()	マクロブロックが内部符号化されていて、映像層内のintra_ vlc_ formatフラグが同時に立つ時、1に戻る。他の場合、0に戻る。	0000
zero_run()	全部0のストリングの場合、6ビットだけシフトすることを別として、MSBの相次ぐ0のビット長が5ビット以内である時、(戻った値+1)ビットだけシフトする。	0001
one_run()	全部1のストリングの場合、4ビットだけシフトすることを別として、MSBからの相次ぐ1のビット長だけ4ビット以内で戻し、(戻った値+1)ビットだけシフトする。	0010
1st_coef()	問題とする8×8ブロック内で復号された先行する係数がない場合、1に戻る。他の場合、0に戻る。	0011
get_bit(1)	次のビットに戻り、1ビットだけシフトする。	0100
cpm_2bit(0)	次の2ビットが'00'に等しければ、1に戻り、そうでなければ、0に戻り、1に戻る時だけ2ビットだけシフトする。	0101
cpm_2bit(2)	次の2ビットが'10'に等しい場合、1に戻り、そうでない場合、0に戻り、1に戻る時だけ、2ビットだけシフトする。	0110
term_#0()	M(R, 1)によってアドレスされた係数で終了する。	0111
term_#1()	M(R, 2)でアドレスされた係数で終了する。	1000
term_#2()	M(R, 3)でアドレスされた係数で終了する。	1001
term_#3()	M(R, 4)でアドレスされた係数で終了する。	1010
term_#4()	escape_ codeシンタクスによる係数で終了する。	1011
term_#5()	係数(R_0, R_1)で終了する。	1100
term_#6()	係数(0, R_1+1)で終了する。	1101
term_#7()	係数(1, 1)で終了する。	1111
term_#8()	係数(0, 8)で終了する。	1110
注	MSB:最上位ビット	

[0072]In Table 4, M (R, n) (n= 1, 2, 3, 4 ....) is a mapping function defined as follows.
[0073]
[Equation 12]
M(R,n)=Table [R][getbit (n)] (12)
[0074]R is eight bit registers defined by the following form here.
Semantics is shown in Table 5.
This is named a status register. get-bit (n) is a function to which the decimal values of the following n bit are returned, and only n bit is shifted.
[0075]
[Equation 13]
R**X;R0;R1;R2 (13)
[0076]
[Table 5]

成 分	成 分 の 記 述	必要なビット数
X	intra_ vlc_ formatに相当する。	1
R_0	#1アドレスオペレーションから戻った値を記憶する。	3
R_1	#2アドレスオペレーションから戻った値を記憶する。	3
R_2	#3アドレスオペレーションから戻った値を記憶する。	1
注	全てのレジスタ成分が、係数を復号する前に0にリセットする。	

[0077]C source language can describe operation term-#4 (), i.e., escape-code, as follows.
[0078]
[Equation 14]

```
term_#4()
{
    run=get_bit( 6 );
    if(MPEG-2){ /* MPEG-2 stream */
        level=-2048*get_bit( 1 );
        level=level+get_bit( 11 );
    }
    else{ /* MPEG-1 stream */
        index=get_bit( 8 );
        if( index==0x00 ) /* level>=128, 28bit-code */
            level=get_bit( 8 );
        else if( index==0x80 ) /* level<=-128, 28bit-code */
            level=get_bit( 8 )-256;
        else{ /* abs(level)<128 */
            if( (index>>7)==0 ) /* level>=1, 20bit-code */
                level=index;
            else
                level=(index&0x7f)-128;
        }
    }
}
```
(14)

[0079]Here, the coefficient table used for the method concerning this invention is defined. In this case, each code is accessed as an item of a two dimensional array. For example, [0;0;0;0] [0] is equivalent to (N/A, EOB).

[0080]

[Table 6]

R	テーブル (R) の内容
0;0;0;0	(N/A,EOB), (0,1)
0;1;0;0	(0,2), (2,1)
0;2;0;0	(N/A,N/A), (0,3), (4,1), (3,1)
0;2;1;0	(13,1), (0,6), (12,1), (11,1), (3,2), (1,3), (0,5), (10,1)
0;3;0;0	(7,1), (6,1), (1,2), (5,1)
0;4;0;0	(2,2), (9,1), (0,4), (8,1)
0;6;0;0	(16,1), (5,2), (0,7), (2,3), (1,4), (15,1), (14,1), (4,2)
0;6;1;0	(0,11), (8,2), (4,3), (0,10), (2,4), (7,2), (21,1), (20,1), (0,9), (19,1), (18,1), (1,5), (3,3), (0,8), (6,2), (17,1)
0;6;2;0	(10,2), (9,2), (5,3), (3,4), (2,5), (1,7), (1,6), (0,15), (0,14), (0,13), (0,12), (26,1), (25,1), (24,1), (23,1), (22,1)
0;6;3;0	(0,31), (0,30), (0,29), (0,28), (0,27), (0,26), (0,25), (0,24), (0,23), (0,22), (0,21), (0,20), (0,19), (0,18), (0,17), (0,16)
0;6;4;0	(0,40), (0,39), (0,38), (0,37), (0,36), (0,35), (0,34), (0,33), (0,32), (1,14), (1,13), (1,12), (1,11), (1,10), (1,9), (1,8)
0;6;5;0	(1,18), (1,17), (1,16), (1,15), (6,3), (16,2), (15,2), (14,2), (13,2), (12,2), (11,2), (31,1), (30,1), (29,1), (28,1), (27,1)
1;0;2;0	(0,4), (0,5)
1;0;3;0	(9,1), (1,3), (10,1), (0,8)
1;0;4;0	(0,9), (N/A,N/A), (0,12), (0,13), (2,3), (4,2), (0,14), (0,15)
1;1;1;0	(N/A,EOB), (0,3)
1;2;1;0	(1,5), (11,1), (0,11), (0,10), (13,1), (12,1), (3,2), (1,4)
1;2;0;0	(N/A,N/A), (2,1), (1,2), (3,1)
1;3;0;0	(0,7), (0,6), (4,1), (5,1)
1;4;0;0	(7,1), (8,1), (6,1), (2,2)
1;6;0;1	(2,4), (16,1)
1;6;0;0	(5,2), (14,1), (N/A,N/A), (15,1)
Note	EOB: End of block, N/A: Not applicable

[0081]Drawing 12 shows the decoding algorithm concerning one example of this invention, and shows the VLC decoding algorithm which has such operations when not acting, the case of 0, i.e., intra-vlc-format, of a DCT coefficient table. In this figure, R0 and R1 are calculated and this corresponds to the 1st address operation (block 21) and the 2nd address operation (block 22) in the block diagram of drawing 11. This process does not cover a sign bit. This is because it can treat easily if other precedence portions of VLC are known. This algorithm shows the decoding process of one code. However, it can be jumped over the first judgment routine, i.e., use-intra-vlc(). It is because the value to which this returned while image layer syntax intra-vlc-format was not acting is being fixed to 0. Therefore, in the state of saying like this, it can start from the next operation, i.e., zero-run(), and a decoding process sets X to 0 compulsorily. Before status register R applies use-intra-vlc(), it should still be reset to 0; 0; 0; 0.
[0082]When intra-vlc-format is acting, another algorithm shown in drawing 13 is used. In this figure, R0, R1, and R2 are calculated, and this corresponds to the 1st operation (block 21) in a block diagram, the 2nd operation (block 22), and the 3rd operation (block 23) of drawing 11.
[0083]As shown [drawing 13 / drawing 12 and] in drawing 11, in order to decode a coefficient except for operation use-intra-vlc(), it turns out that the VLC decoding method concerning this invention needs at most three address operations.
[0084]Table 7 shows an example of a VLC decoding process when a binary string '00100010' appears. It is a table as a decoding result. [0:2:1:0] It is shown that [2] is obtained. That is, a

binary string '00100010' corresponds to a code (12, 1). The vertical bar between the bits shown in the column of the "current position" of Table 7 shows the pause (pause which makes a unit operation which is not a pause of a symbolic language and starts this invention) of a bit string. In the example of Table 7, the input bit sequence is flowing into the left from the right, information is already extracted from there and the bit string which is on the left of a pause is regarded as data which does not have on future decoding processing.
[0085]
[Table 7]

プロセス段階	適用するオペレーション	戻る値/係数	$X;R_0;R_1;R_2$	現在位置
			0;0;0;0	|00100010
＃1オペレーション	zero_run()			
		2	0;2;0;0	001|00010
＃2オペレーション	cpm_2bit(0)			
		1	0;2;1;0	00100|010
＃3オペレーション	term_#2()			
		[R] [2]	0;2;1;0	00100010|

[0086]It is verified by the simulation that the method concerning this invention decodes a DCT coefficient correctly from coded various bit strings.
[0087]This method enables 154 coefficient code **** VLC decodings (42 pieces receiving 1 of a DCT coefficient table to 0 of a DCT coefficient table 112 pieces) as well as the case of reduction of the scale of a table. On the other hand, 432 coefficient codes are used for the decoding method considered by the MPEG software-simulation group (MSSG). For a precise comparison, Table 8 is the number of bits taken to express a code item to each method, and shows the format of the coefficient table. Eventually, the scales of a table are 1,694 bits (154x11) and 6,912 bits (432x16) to the method and MSSG decoding method which start this invention, respectively. When the ratio is said roughly, it is equal to 4:1.
[0088]
[Table 8]

方　式	データ	範囲（10進）	必要なビット数	必要なビット数の総計
MSSG	ラン (run)	0−31, EOB, ESCAPE	6	16ビット/コード
	レベル(level)	1−40	6	
	コード長	1−16	4	
本発明	ラン (run)	0−31	5	11ビット/コード
	レベル(level)	1−40, EOB, ESCAPE	6	
注：ESCAPEは、escape_code シンタクスに従って扱わなければならないことを意味する。				

[0089]Speaking of a bus architecture, a MSSG decoding method needs an 8-bit address bus. This is because the maximal term number of division of a coefficient table is 250. On the other hand, in the method concerning this invention as shown in Table 6, a 4-bit address bus is enough.
[0090]As mentioned above, since decoding can be advanced acquiring the information (status register) for decoding for every stage, and updating a current position, the field which expresses code length to the coefficient table referred to eventually becomes unnecessary, and only the part can reduce a coefficient table. Since the address bit length at the time of furthermore referring to a coefficient table is made to 4 bits to 8 bits of the former (MSSG), the number of entries of a coefficient table can be reduced by half. A coefficient table is made into conventional 1/3 thru/or 1/4 by these two effects.
[0091]Another invention is explained below. This invention relates to the motion compensation of a video picture signal. In the coding mode using the conventional motion compensation, the

unit. In recent years, the method which performs a motion compensation by the block unit of variable size as shown in drawing 14 as what improved this is examined. By this technique, a frame is divided into a small block in homogeneous fields, such as a background, near the object again at a big block. The purpose is to transmit motion information finely near the object which an error tends to generate, and is controlling the error generated with the whole frame. However, in this variable size-block motion compensation, when the information for block division is transmitted by the data of a tree structure for 4 minutes, the problem that an overhead becomes large to the profit of coding is pointed out. So, in the proposal technique, in order to reduce this overhead, variable size-block division is performed by extracting and transmitting edge information. That is, the proposal technique is a motion compensation coding mode characterized by the variable size-block division based on edge.

[0092]By the edge extraction by pursuit of the pixel unit used from the former, since the amount of information of an overhead becomes large, in order to prevent this, by the proposal technique, the method of expressing edge approximately not by a point but by a line segment is adopted. The functional block diagram of a block division algorithm is shown in drawing 15.

[0093]First, the break point of a luminance change is extracted by covering a secondary differentiation filter over an original image (or decoding frame). And two steps of grouping processings are performed to a set of the point (it is called an edge point) acquired by the threshold process, and the line segment expressing objective shape is extracted. In the 1st-step grouping processing, the line segment (it is called a unit line segment) which had deed directivity for template matching of a set of an edge point and the line segment pattern mask with a size of 5x5 pixels quantized in the eight directions is extracted (block 61). This is extraction of a unit line segment.

[0094]Next, extraction (block 62) of a macro line segment is explained. Since human being's visual center cell has the character (this is called orientation selectivity) to react per 10 degrees to rotation of an object, in the 2nd-step county-ized processing, it combines the unit line segment which follows a uniform direction, and extracts the line segment (it is called a macro line segment) quantized in the 16 directions. The example of a macro line segment is as being shown in drawing 16. The data format expressing a macro line segment is the two-dimensional coordinates, the direction (the one direction of the inside quantized to 16), and length (joint pixel number) of a corner point of each line segment.

[0095]And in block division (block 63), equal segmentation of the frame is carried out with a big block (the permission maximum block) at first (this is called the 1st layer), and if a macro line segment exists in each block, it will divide into four small blocks (this is called the 2nd layer). And it repeats until it obtains the permission minimum block which specified this operation beforehand. In block division of drawing 16, from the 1st layer to the 3rd layer exists.

[0096]It did not depend for the amount of information of the overhead on the contents of the picture from an old experimental result, but when it was division up to the 2nd layer, when the proposal technique and a 4-minute tree structure were equivalent and the 3rd more than layer mostly, they checked the thing with few (it is got blocked and is advantageous) proposal techniques. Although the block shown by the drawing 14 destructive line usually performs edge extraction on an original image by the proposal technique, it shows that there is a method of using as an alternative the frame decoded before. In this alternative, since a decoding frame equal in both the local decoding-ized part [by the side of coding] and decryption sides exists, it uses that the edge which will be obtained if the edge extraction method is the same also becomes equal. I hear that the overhead of the advantage of this technique is lost, and there is. However, since it is premised on the decoding frame and the frame actually processed being similar, when a difference arises to both, mistaken division will be performed and encoding efficiency falls. Therefore, the mechanism which switches the case where the case where an original image is used, and a decoding frame are used, accommodative is needed.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The figure showing an example of a multilayer display.
[Drawing 2]The figure showing the QT code of the multilayer display example shown in drawing 1.

[Drawing 3]The block diagram of the encoder concerning one example of this invention.
[Drawing 4]The figure explaining the reduced image.
[Drawing 5]The block diagram of the marginal extraction part in the encoder of drawing 3.
[Drawing 6]The figure showing the small segment pattern of eight directions.
[Drawing 7]The figure explaining detection of a macro edge.
[Drawing 8]The figure showing an example of a marginal belt.
[Drawing 9]The figure showing an example of ******.
[Drawing 10]The graph which measures the data speed of the multilayer display by a simulation.
[Drawing 11]The block diagram showing the concept of the decoding method concerning other inventions.
[Drawing 12]The figure explaining the decoding algorithm concerning one example of other inventions (when a DCT coefficient table is 0).
[Drawing 13]The figure explaining the decoding algorithm concerning one example of other inventions (when a DCT coefficient table is 1).
[Drawing 14]The block diagram explaining one example of another invention.
[Drawing 15]The figure explaining the algorithm in another invention.
[Drawing 16]The figure explaining block division.
[Description of Notations]
1 Parameter determination part
2 Image reducing part
3 Marginal extraction part
4 Multilayering part
5 Coding part

[Translation done.]

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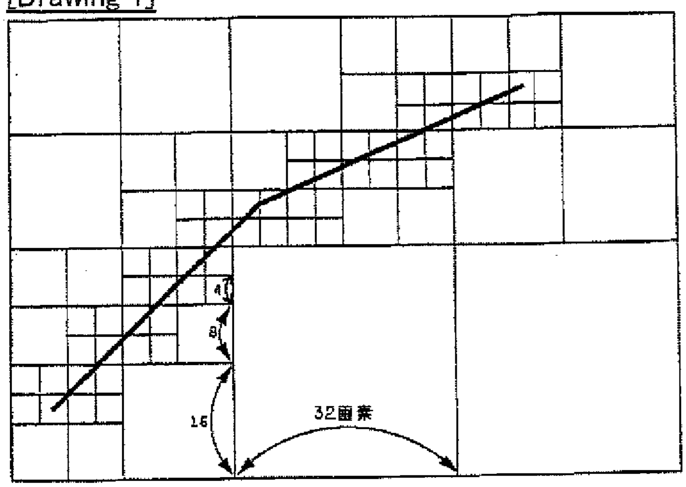
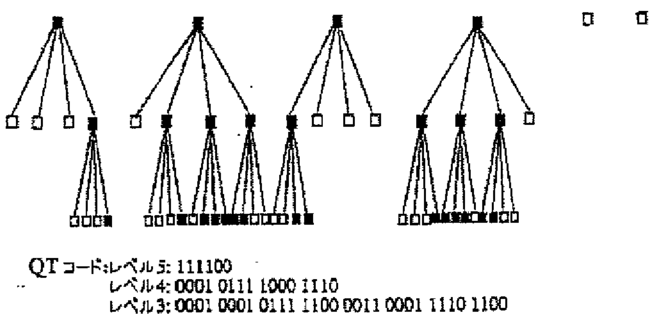
DRAWINGS

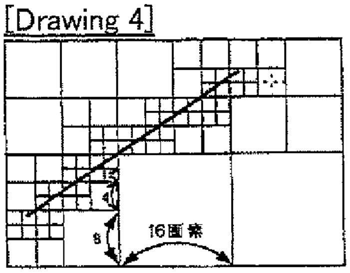
[Drawing 1]



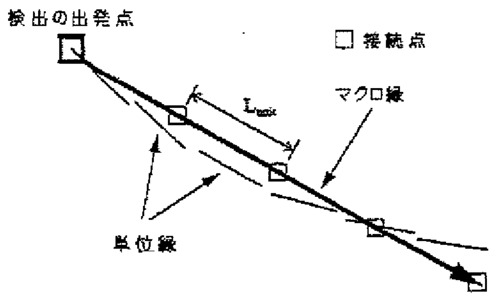
[Drawing 2]



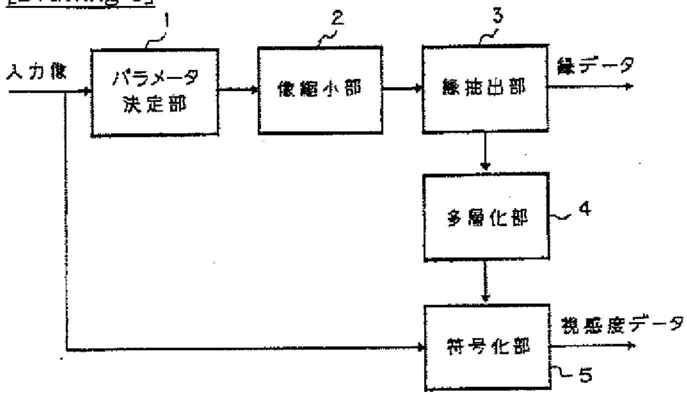
[Drawing 4]



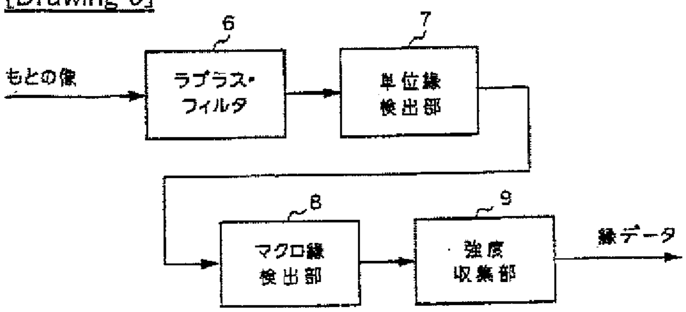
[Drawing 7]



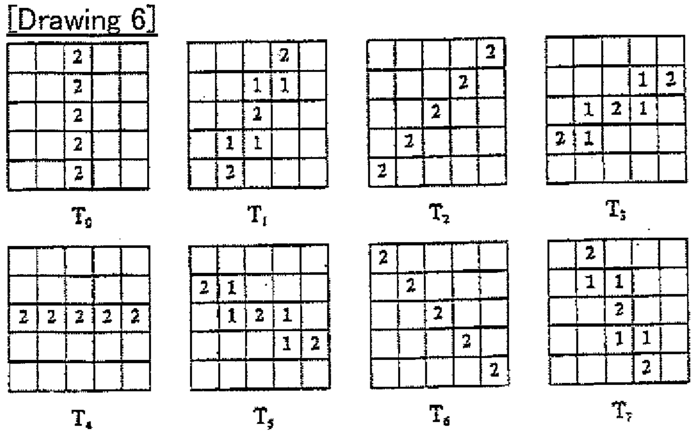
[Drawing 3]



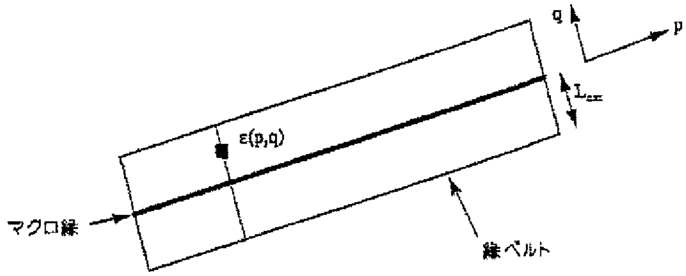
[Drawing 5]



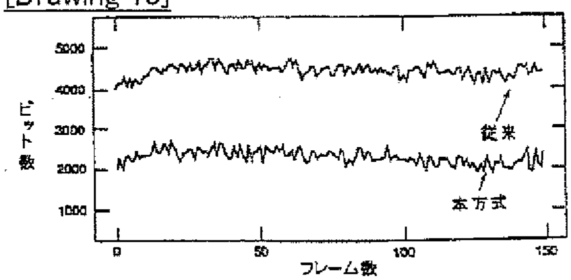
[Drawing 6]



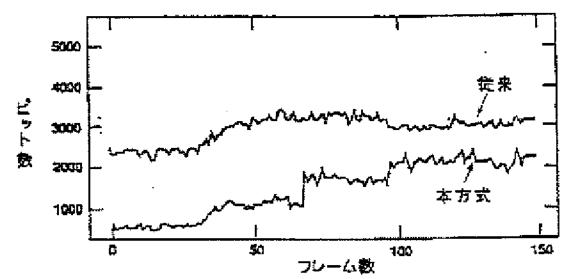
[Drawing 8]



[Drawing 10]

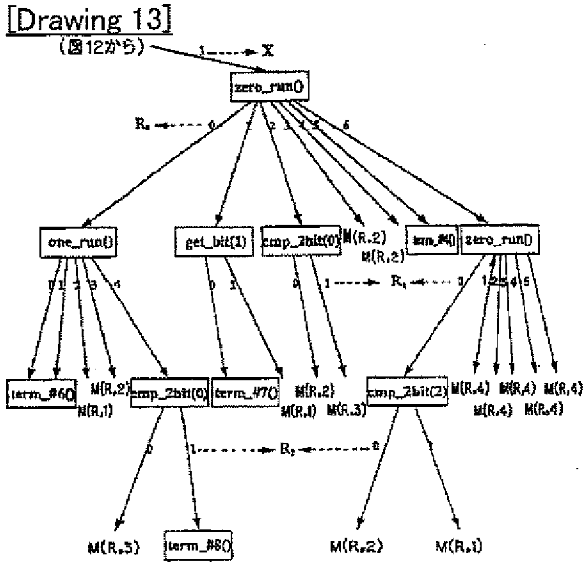


(a)フラワー・ガーデン

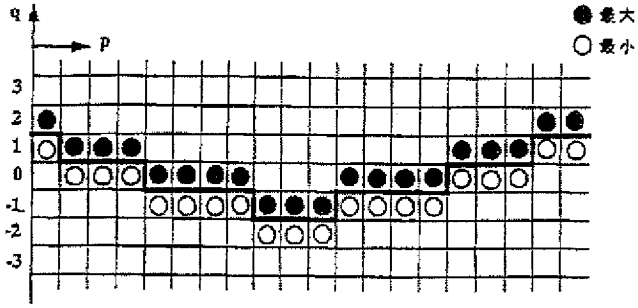


(b)テーブル・テニス

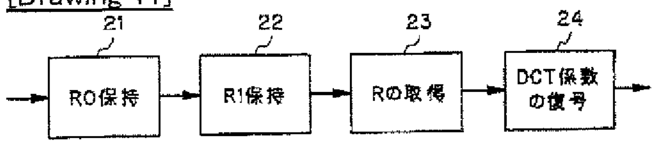
[Drawing 13]



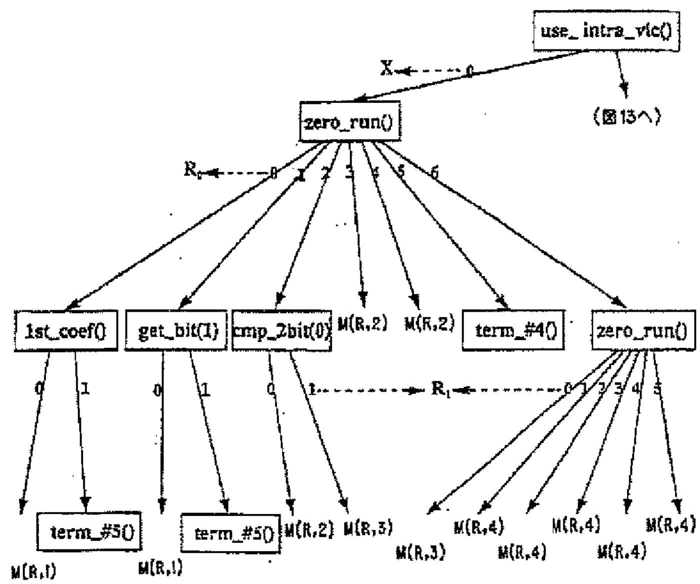
[Drawing 9]



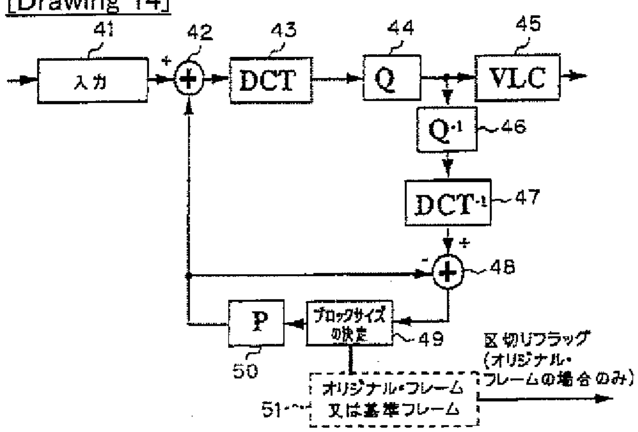
[Drawing 11]



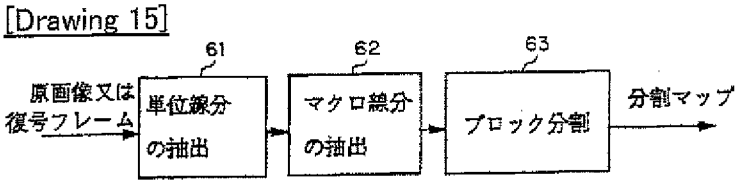
[Drawing 12]



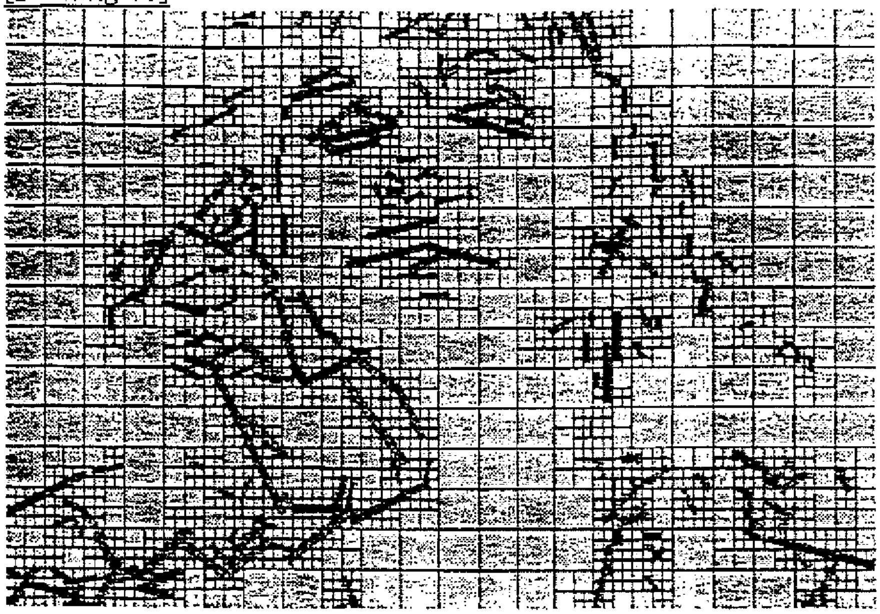
[Drawing 14]



[Drawing 15]



[Drawing 16]



[Translation done.]